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Contents

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VOL. 22, SEC. D. JUNE, 1944 NUMBER 3

STUDIES ON FACTORS INFLUENCING THE HEALTH OF PIGS

II. THE INCIDENCE OF THE ROUNDWORM (*ASCARIS LUMBRICOIDES*) IN PURE-BRED BACON PIGS IN CANADA, WITH OBSERVATIONS ON AGE OF SUSCEPTIBILITY AND EFFECTS ON GROWTH[1]

BY L. P. E. CHOQUETTE[2] AND W. E. SWALES[3]

Abstract

Infections with *Ascaris lumbricoides* were found in approximately 75% of 1090 pigs in Advanced Registry Test Stations. Most of these infections were acquired by the pigs during the preweaning period. The infections recorded were not definitely harmful to the animals. Studies on factors influencing ascariasis are in progress.

Introduction

Ascaris lumbricoides Linn., 1758, is a common worm parasite of pigs in Canada. That its role in the production of disease is poorly understood is evidenced by frequent records of large numbers of this parasite in apparently healthy pigs and, on the other hand, by frequent records of fatalities in these animals due to ascariasis. Anthelmintic medication of pigs is widely practiced. For these reasons it was deemed necessary to conduct a survey of a population of apparently normal pigs in Canada to obtain data as a basis for further work.

The Live Stock and Poultry Division, Production Service, Dominion Department of Agriculture, conducts Advanced Registry Pig Testing Stations in various parts of the Dominion. The officers responsible for the tests are frequently concerned with the question of possible roundworm infections and readily agreed to co-operate in a survey of the pure-bred pigs as they entered and progressed through the stations. The four stations selected for the survey were located at Charlottetown, P.E.I., St. Hyacinth, Que., Fort Garry, Man., and Saskatoon, Sask.

When the pigs enter the stations they are about 65 days old; the test commences when they are 70 days old, four pigs from one litter being kept as one entry. The methods of feeding and general care are the same for all the pigs at each station. As pigs have to attain a certain standard of weight before entering the stations it must be emphasized that these animals constitute a selected population from pure-bred herds.

[1] *Manuscript received January 10, 1944.*

Contribution from the Institute of Parasitology, Macdonald College, McGill University, and the Division of Animal Pathology, Science Service, Dominion Department of Agriculture, with financial assistance from the National Research Council of Canada.

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Procedure

Microscopic examinations of the faeces of each pig were made at 70, 84, 98, and 126 days of age respectively and one more test was made a few days before a pig was sent to the abattoir.

Each faecal sample was tested qualitatively by the sugar solution levitation method. If eggs of *Ascaris* were present, a quantitative test was applied. This latter test was a modification of the Stoll technique for estimating nematode ova in sheep faeces (8). The results were reported as eggs per gram of faeces.

Results

Each of 1090 pigs was tested at the aforementioned intervals between February, 1940, and July, 1941. In 1940, 74.9%, and in 1941, 75% of the pigs tested were found to be infected to some degree at some period of their lives. As these two percentages are almost identical the records for the two years are considered together in subsequent treatments. The incidence of infection and its distribution according to the month of birth of the pigs is shown in Table I.

TABLE I

INCIDENCE OF INFECTION AND THE MONTH OF BIRTH OF THE PIGS

Month of birth	No. of pigs	No. positive	Percentage positive
January	104	81	77.9
February	108	83	76.3
March	273	191	69.9
April	159	140	88.0
May	32	29	90.6
June	27	17	63.1
July	126	100	79.4
August	102	73	71.6
September	80	52	65.0
October	43	27	62.8
November	20	13	65.0
December	16	11	68.8
	1090	817	74.9

Owing to the great variation in numbers of pigs available for test during certain months, the differences between months as shown in Table I could not be shown to be significant. The factors most likely to cause differences in susceptibility and exposure to Ascaris infection are the housing and diet of the pigs. Pigs kept outdoors when young are under very different conditions from those kept in buildings without access to soil, vegetation, or sunlight. Those born between October first and the end of April would, in most cases, be confined to barns, while those born during the remainder of the year would probably have access to outdoor conditions. However, in dividing the pigs according to this theory it was found that 75.5% of the "indoor" group, and 73.8% of the "outdoor" group, were positive; thus there was no appreciable difference in incidence between the groups.

The differences between provinces are shown in Table II. Saskatchewan and Prince Edward Island pigs had a somewhat higher incidence of worms than those from the other two provinces, but the differences are not sufficiently great to warrant further investigation of this point.

TABLE II

INCIDENCE OF INFECTION, BY PROVINCES

Province	No. of pigs	No. positive	Percentage positive
Prince Edward Island	91	77	84.6
Quebec	621	434	69.8
Manitoba	132	100	75.7
Saskatchewan	246	206	83.7

Apparent Age of Susceptibility

It is important, for purposes of control, to know in which period of a pig's life Ascaris infection is acquired. The time required for *Ascaris* to reach sexual maturity after the ingestion of infective eggs by the pig host varies between 49 and 75 days (1, 2, 4, 5, 6). Thus, the appearance of the eggs in the faeces indicates roughly the time of primary infection. It is, therefore, apparent that the pigs found to be positive at the age of 70 days were exposed during the first few days of life; those first positive at 84 or 98 days acquired their infection somewhat later in the suckling period, and those positive at 126 days or later, were infected after they were weaned. Table III shows the distribution of the pigs that were first found to be infected at the various ages. It will be noted that approximately 60% of the pigs acquired Ascaris infection during the nursing period.

TABLE III

AGES AT WHICH INFECTION WAS FIRST DETECTED

Ages	No. of pigs found positive	Percentage	Probable age of initial infection, days
70 days	202	25.4	1 – 20
84 days	147	18.5	10 – 35
98 days	128	16.1	23 – 50
126 days	190	23.9	51 – 77
Over 126 days	129	16.2	70 – 130
	796*		

* *Twenty-one pigs not included because of incomplete records at one age.*

The obvious practical importance of age of the pig at the time of initial infection led to further observations on the weight of infection acquired at various ages. As the quantitative determination of the worm eggs in the

faeces roughly indicates the number of parasites present, these counts are used as indications of severity of infection. The counts were divided into groups; less than 1000, 1000 to 5000, 5000 to 10,000, and over 10,000 eggs per gram of faeces were selected. These counts were recorded at one or more stages of the pig's life. Table IV shows the figures obtained in the various groups; it was noted that a majority of the "heavy" infections were acquired during very early life, and that most of those acquired in late life were comparatively light.

TABLE IV

SEVERITY IN RELATION TO TIME OF INFECTION

Weight of infection, eggs/gm. faeces	Age of pig at time of detection (days)					
	70	84	98	126	>126	Total pigs*
<1000	18	30	30	76	78	232
1000 – 5000	67	68	72	79	48	334
5000 – 10,000	46	31	22	21	3	123
>10,000	61	20	5	12	1	99
						788

* *Twenty-nine pigs not included in this and subsequent tables because of insufficient faecal samples for quantitative determinations.*

An attempt was then made to see if there was any relationship between the severity of infection and the time of year at which the pig was born. The "indoor" and "outdoor" groups were as used before. The results are shown in Table V. Statistical analysis (Chi square test) failed to reveal any significant difference between the groups.

TABLE V

RELATION OF SEASON TO SEVERITY OF INFECTION

Probable conditions of early life	No. of infected pigs	Weight of infection (×1000 eggs/gm. faeces)			
		<1	1 – 5	5 – 10	>10
Indoor (Oct.–April)	533	167 (31.3%)	229 (43.0%)	73 (13.7%)	64 (12.0%)
Outdoor (May-Sept.)	255	65 (25.5%)	105 (41.2%)	50 (19.6%)	35 (13.7%)
Totals	788	232	334	123	99

The Effect of Infection on Rate of Growth

The records of gain in weight of all pigs are continuously kept at the Stations and these data were made available to us. The same criteria of severity of infection (eggs per gram of faeces) were used for comparison.

Observations on 1061 pigs were possible; records on 26 other pigs were incomplete. The results are shown in Table VI. The difference of 0.05 lb. gain per day between the pigs free of *Ascaris* and those passing more than 10,000 eggs per gram of faeces at some period of their lives, was found to be just significant by the analysis of variance. No other significant difference is present between any other two groups.

TABLE VI

RELATION OF INFECTIONS TO RATE OF GAIN IN WEIGHT

Weight of infection (eggs per gm. faeces)	No. of pigs	Average daily gain from 70 days of age to slaughter
0	273	1.37 lb.
<1000	232	1.35 lb.
1000 – 5000	334	1.34 lb.
5000 – 10,000	123	1.33 lb.
>10,000	99	1.32 lb.

Analysis of variance

Variance due to:	D.f.	Mean square	S.d.	*F* values	
				Observed	Necessary
All causes	1060				
Between infection	4	0.0804	0.273	2.7	2.38
Residual	1056	0.298	0.190		

The Relation of Egg Counts to Number of Worms Present

In order to interpret the egg counts in terms of worms in the intestines a number of pigs have been examined after slaughter, less than 48 hr. after a quantitative estimation of the worm eggs. In the 36 pigs examined very large discrepancies were evident and it became apparent that egg counts were only a rough means of determining the number of worms. Female worms only were found in three out of eight pigs negative to the test for eggs; this fact suggests that males are necessary for egg production and that unfertilized eggs are not produced in appreciable numbers. The only two pigs that had counts over 10,000, each had 10,200 eggs per gram of faeces; as pigs rarely retain heavier infections to market age (as observed in this study), it is difficult to obtain data for the counts well over this figure. The results of the observations are presented in Table VII.

Discussion

In considering our results it must be remembered that the pigs concerned were a selected group in that they were, of necessity, in good general health at weaning time. The observed incidence of approximately 75% in these

TABLE VII

RELATION OF EGG COUNTS TO NUMBER OF FEMALE WORMS

Eggs/gm. faeces	No. of pigs	Mature female worms recovered at autopsy			
		Maximum	Minimum	Average	S.d.
0	8	2	0	0.75	
<1000	4	4	1	1.75	2.63
1000 – 5000	16	19	2	6.69	4.30
5000 – 10,000	6	22	5	12.50	5.31
>10,000	2	32	14	23.00	12.60

pure-bred pigs is, however, remarkably similar to the finding of Spindler (7) that 74% of 348 pigs in the southern United States harboured *Ascaris*.

It is apparent that the infections here recorded were not very harmful to the host. However, this cannot be interpreted to mean that *Ascaris lumbricoides* is not a pathogenic parasite in pigs; rather it shows that in pigs that resisted the effects of potential pathogens up to weaning age, and were thereafter kept under good conditions of housing and nutrition, such infections as we record are not highly important.

Our failure to show a definite difference in incidence or severity of Ascaris infection between the pigs born and suckled indoors, and those that we believe were kept outdoors during their early life, was surprising. In the many piggeries in Quebec in which investigations have been made (3), the heaviest losses have been suffered in the late winter and early spring, when nutritional anaemia, vitamin and mineral deficiencies, and ascariasis have been found. The lack of such a seasonal difference in this study might be due to the greater care given pure-bred registered animals on farms under "indoor" conditions.

In considering our barely significant finding that the pigs with the highest infection gained at a lower rate than those that had no worms, we must be guarded in our interpretation. The worms could be the cause of this decrease in rate of gain, or they could have been retained because of another weakness; in other words, we have not demonstrated whether they are the cause or the effect.

The observations recorded here are now being used as a foundation for studies on factors influencing resistance or susceptibility to ascariasis.

Conclusions

A survey of pure-bred pigs in four provinces of Canada has shown that approximately 75% are infected with adult *Ascaris lumbricoides* some time between the ages of two and six months. The infections recorded are not highly pathogenic in pigs over two months old when they are kept under good conditions of nutrition and housing.

Approximately 60% of all infections, and 87% of the heaviest ones, were acquired during the nursing period.

No definite seasonal variation in incidence was found.

Acknowledgments

The authors are indebted to the officers and employees of the Production Service, Live Stock and Poultry Division, Dominion Department of Agriculture, for their excellent co-operation with the survey. In this connection particular mention should be made of Mr. J. G. Lefebvre, Supervisor, Advanced Registry Test Stations, Messrs. J. P. Fleury and A. Desrosiers, and the operators of the four stations concerned.

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STUDIES OF WATERFOWL IN BRITISH COLUMBIA

PINTAIL[1]

By J. A. Munro[2]

Abstract

Dafila acuta is an abundant transient through British Columbia following routes along the outer coast, the inner coast, and the main north and south river systems of the interior. The spring migration takes place during March and April and is not protracted but the autumn migration is one of successive movements from mid-August to early December. The largest flight sometimes appears on the mainland coast in late October. Both northbound and southbound flocks concentrate on the Coastal Plain. The chief wintering grounds are in western Oregon and in California, the most densely populated nesting grounds in Alaska. Recoveries of banded birds have verified observational migration data and have shown also that many individuals use the same route in successive years, some arriving at a given point on approximately the same date. In British Columbia the principal nesting ground is the parklands of the Cariboo region and the peak of the spring migration is in late March or early April. Following its conclusion the residual population is scattered over a wide area characterized by grassland and many types of ponds and sloughs. Courtship is at its height in April and laying commences in May. Nest sites usually are dry and may be several hundred yards from the nearest water. The majority of young appear in June and are led by the females to meadows and marshes provided with adequate cover. The females remain with the brood and actively defend them during adolescence. Males leave the females when incubation begins and gather in small bands on water adjacent to the nesting grounds. Many migrate in advance of the flightless period. Downy young feed largely on the larvae of aquatic insects. The most important item in the diet of adults during autumn and winter is seeds of various meadow and aquatic plants. On the coast this element is characterized by Polygonaceae and *Scirpus americanus*, in the interior by Potamogetons and *Scirpus acutus*. Insects and animal matter generally constitute a less important food. The pintail is second to the mallard, *Anas platyrhynchos*, in economic importance and like it is a source of revenue to the Province. On the debit side the pintail causes some loss to agriculture by eating forage crops but this is not extensive and is amenable to control.

Introduction

The pintail, *Dafila acuta* (Linnaeus), is widely distributed on the Pacific slope of North America, nesting from southern California to Alaska and wintering from southeastern Alaska and the Queen Charlotte Islands to Central America. It is recorded in winter from the Hawaiian Islands (1) and there is a recent account of its appearance on Palmyra Island 1100 miles south of Honolulu (4). Alaska is the most important nesting ground for Pacific coast populations and the main wintering grounds are in Oregon and California. Many, perhaps most, of the migrations from these extremes of north and south pass through British Columbia, hence it is conspicuous there as a transient. The wintering populations in the Province vary greatly in

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Contribution from the National Parks Bureau, Department of Mines and Resources, Ottawa, Canada.

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size from year to year and the largest are recorded from the Fraser delta. This species nests regularly in fair numbers on the central interior plateau, less commonly in the southern and eastern portions of the Province. In both winter and summer it exhibits definite habitat preference.

In this paper is presented information concerning distribution and migration of the species in the Pacific coast region, as determined chiefly by banding data, and observations of life history, behaviour, and food habits as studied in British Columbia.

Distribution and Seasonal Movements

Coast Region

Apparently the first pintails to be banded in British Columbia, some 30 birds, were captured, in September 1923, on Ione Island, situated in the Fraser River near its mouth, and, from these, nine bands subsequently were recovered. In the spring of the following year 13 were banded on Lulu Island in the Fraser delta and six were recovered. In 1925 a single specimen, trapped and banded near Victoria, Vancouver Island, was shot near the same place in the autumn of that year. From 1928 to 1940 a total of 1281 banded at Station 1 and from 1932 to 1935 a total of 5187 banded at Station 3 represent the most successful operations, the numbers banded at three other stations being insignificant. The position and other details concerning these stations and definitions of various terms used in classifying banding data are included in an earlier paper of this series (5).

The total of pintails banded at all these stations was 6554; the recoveries, including 99 records of birds retaken at the station where they were banded, or at a different station, number 1154 as at December 31, 1943. (See Table I. A summary of returns by provinces, states, and territories is given in Table II. See also Fig. 1.) Of this total 926 were taken in the first year after banding and the remainder as follows: 2nd year, 140; 3rd year, 36; 4th year, 19; 5th year, 14; 6th year, 6; 7th year, 5; 8th year, 1; 9th year, 5; 11th year, 2.

TABLE I

Number of pintails banded in British Columbia and total recoveries

Banding periods	Number banded		Totals	Totals recoveries	Recovery, %
	♂	♀			
Ione Island, 1923			30	9	30.0
Lulu Island					
1921, Mar. 15–April 7	6	7	13	6	46.2
Vancouver Island, 1925	1		1	1	
Station 1					
1928, Oct. 30 – Dec. 31	6	9	15	4	26.7
1930, Oct. 21 – Dec. 5	0	0	0		
1931, Nov. 3 – Dec. 8	3	1	4	2	50.0

TABLE I—*Concluded*

NUMBER OF PINTAILS BANDED IN BRITISH COLUMBIA AND TOTAL RECOVERIES—*Concluded*

Banding periods	Number banded		Totals	Total recoveries	Recovery, %
	♂	♀			
Station 1—*Concluded*					
1932, Oct. 16 – Dec. 9	14	16	30	7	23.3
1933, Mar. 29 – April 18	0	0	0		
Oct. 4 – Dec. 12	298	436	734	120	16.3
1934, Jan. 28 – Mar. 14	0	2	2		
Oct. 7 – Dec. 5	100	138	238	27	11.3
1935, Mar. 5 – April 11	0	0	0		
Oct. 22 – Dec. 31	10	28	38	3	7.9
1936, Jan. 18 – April 11	0	1	1		
Oct. 10 – Dec. 28	1	0	1		
1937, Mar. 19 – April 4	0	0	0		
Oct. 31 – Dec. 12	12	9	21	7	33.3
1938, Nov. 24 – Dec. 31	18	40	58	5	8.6
1939, Jan. 1 – April 19	24	34	58	4	6.9
Nov. 14 – Dec. 31	38	38	76	6	7.9
1940, Jan. 1 – Mar. 31	2	3	5		
Station 2					
1933, Feb. – April	1	2	3		
1934, Feb. – April	4	5	9	1	11.1
1935, Feb. – April	1	0	1		
Station 3					
1932, Oct. 3 – Dec. 31			1488	269	18.1
1933, Jan. 1 – Feb. 19			39	3	7.7
Sept. 4 – Dec. 17			2714	587	21.6
1934, Oct. 9 – Dec. 31	204	689	893	85	9.5
1935, Jan. 1 – Jan. 20	16	37	53	1	1.9
Station 4					
1931, Nov.			3	1	33.3
1932, Nov. 1 – Nov. 20			2		
1933, Oct. 30 – Nov. 9					
Station 5					
1932, Aug. 14 – Oct. 6			2	1	50.0
1933, Aug. 30 – Oct. 20			22	5	22.7
Totals	759	1495	6554	1154	
				Average %	21.2

TABLE II

DISTRIBUTION OF TOTAL PINTAIL RECOVERIES

Locality where recovered	Number	Locality where recovered	Number
Alaska	34	Northwest Territories	1
Alberta	8	Nevada	2
Arizona	1	Oklahoma	2
British Columbia	751	Oregon	50
California	40	Saskatchewan	1
Idaho	3	Texas	3
Minnesota	1	Utah	1
Mexico	1	Washington	255
		Total	1154

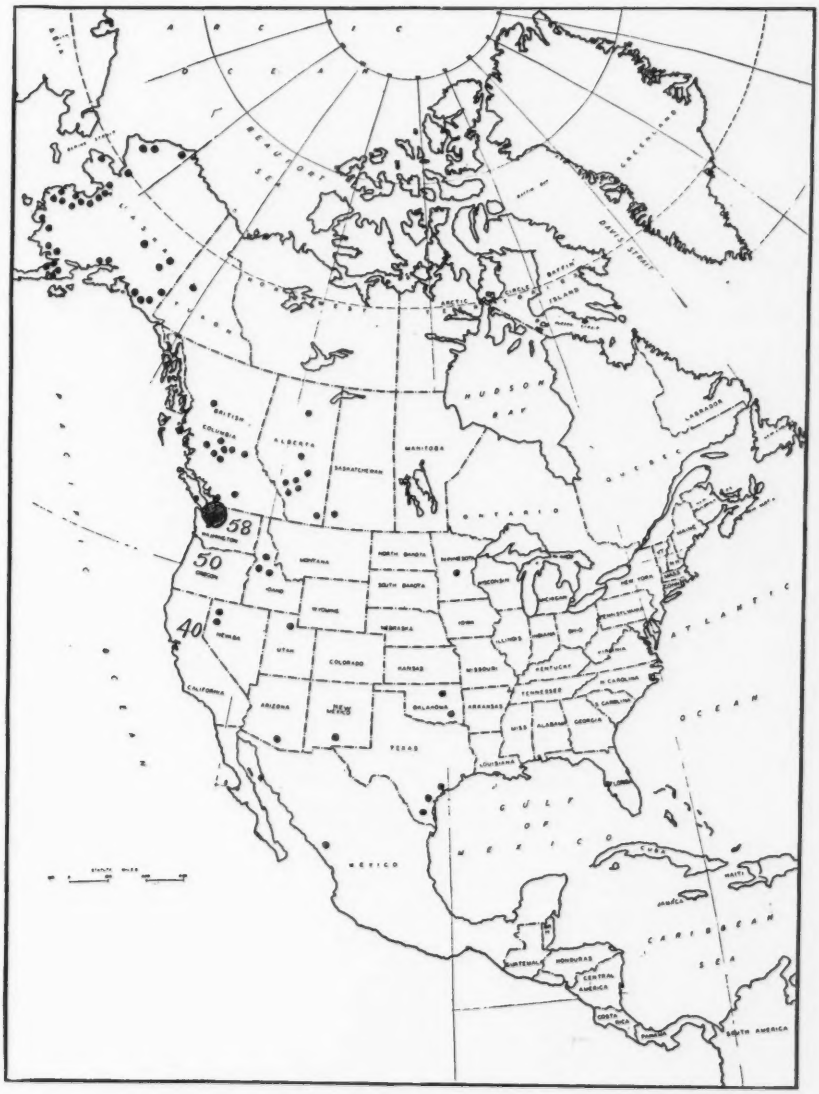

FIG. 1. *Dispersal of pintail banded in British Columbia. Recoveries from Coastal Plain, the hatched area, number 935; other recoveries in Washington State and total recoveries in Oregon and California indicated by figures. Elsewhere each dot represents one or more recoveries.*

The 1148 recoveries of pintails banded on the coast are classified in the following categories, viz.: Coastal Plain—current, 749, or 65.2%, later years, 186, or 16.2% (Table III); south of Coastal Plain—current, 71, or 6.2%, later years, 90, or 7.9% (Table IV); north of Coastal Plain—winter, 4, or 0.3%, spring to autumn, 48, or 4.2%.

TABLE III

RECOVERIES OF PINTAILS, AUTUMN AND WINTER, ON COASTAL PLAIN

Locality where recovered	Current recoveries	Later years	Locality where recovered	Current recoveries	Later years
Banded at Station 1					
British Columbia—			Washington Counties—		
Station 1	34	1	Whatcom	10	2
Sumas–Chilliwack Region	25	5	Skagit	7	6
Station 3	3	1	Snohomish	2	5
Mouth Fraser River	10	3	Island		1
Intermediate Points	12	5	King	2	1
Pitt River Region	10	2			
Vancouver Island		1			
Banded at Station 2					
New Westminster		1			
Banded at Station 3					
Station 3	160	48	Whatcom	26	8
Mouth Fraser River	215	39	Skagit	73	18
Station 1	19		Snohomish	15	6
Sumas–Chilliwack Region	14		Island	6	4
Intermediate Points	61	20	San Juan	1	
Pitt River Region	30	3	King	3	1
Vancouver Island	2	3			
Salt Spring Island	1				
Banded at Ione Island					
Mouth Fraser River	8	1			
Banded at Lulu Island					
Mouth Fraser River		1			
Totals	604	134		145	52

TABLE IV

RECOVERIES OF PINTAILS, AUTUMN AND WINTER, SOUTH, EAST, AND WEST OF COASTAL PLAIN, STATIONS 1, 2, 3

Locality where recovered	Current recoveries	Later years	Locality where recovered	Current recoveries	Later years
Western Washington Counties—			Eastern Washington Counties—		
Clallam	7	5	Chelan		1
Jefferson		1	Yakima	1	1
Mason		2	Grant	1	1
Grays Harbour	4	6	Lincoln	2	
Pierce	1	1			
Thurston	1	3	Eastern Oregon Counties—		
Lewis	1	2			
Pacific	4	6	Klamath	1	2
Clark	2	5			
			Idaho State	2	1
Western Oregon Counties—			California	15	25
			Nevada	1	
Clatsop	3		Arizona	1	
Tillamook	1	1	Utah		1
Columbia		2	Oklahoma		2
Washington	1	2	Texas	2	1
Multnomah	18	10	Minnesota		1
Yamhill		2	Mexico (Sinaloa)		1
Polk	1	1			
Lane		3			
Coos	1	1			
			Totals	71	90

Winter

In discussing the winter distribution of the pintail it will be useful for purposes of comparison to refer to the distribution of the mallard, *Anas platyrhynchos* (5). Whereas the latter is readily adaptable in the matter of food requirements, and thus attracted to numerous types of habitat, the pintail on the other hand is definitely restricted in this regard. It has a limited food range with decided preference for seeds of aquatics, weed seeds, and grasses—hence it is essentially a bird of the fields, ponds, and marshes. Being thus restricted its winter movements are more completely subject to control by weather conditions than are those of the mallard and only in mild, open winters are large populations found wintering on the Coastal Plain. Furthermore no matter what weather conditions prevail a much larger proportion of the pintail population than of the mallard population winters south of this region.

Nine hundred and thirty-five of the 1154 recoveries of pintails come from the Coastal Plain but it is to be borne in mind that the majority probably represent transient and not wintering birds. This is shown by comparison the monthly totals of recovery, viz.; October, 294; November, 433; December, 168; January, 40.

It has been observed that an early flight of pintails, including adult males in eclipse, reaches the southern British Columbia coast in late August and in September. Early dates of arrival on southern Vancouver Island are: Comox, Aug. 12, 1942—20, Aug. 30, 1929—60 (Pearse); Cowichan Bay, Aug. 20, 1939—17 (Cowan). What have been identified as northern bred pintails become common in mid-August on the interior marshes of Oregon and on the inlets along the coast (3) and it must be concluded that many of these early transients pass through British Columbia without resting there. Pintails are still present in Alaska during September and October as the recoveries at the following stations denote, viz.: Ophir, Sept., 1935; Marshall, Sept. 12, 1934; Bethel, Sept. 20, 1934; Kobuk River, Sept. 26, 1933; Anchorage, Oct. 1, 1934; Cordova, Oct. 19, 1936; Petersburg, Oct. 20, 1934.

Another later flight, in which young of the year predominate, arrives on the Fraser delta in early October. A large proportion of this flight and of the earlier ones move south after the opening of the hunting season on the coast of British Columbia in mid-October.

A record of the daily capture of pintails at Station 3 (Westham Island at the mouth of the Fraser River) is not obtainable; however study of the recovery data available makes it evident that in 1932 a flight was at its height from Oct. 3 to Oct. 9, there being a total of 126 recoveries from birds banded in this period. In 1933 a flight probably of larger proportions took place about the same time. This is indicated by the fact that 388 bands were recovered from the total banded on Oct. 8 and Oct. 9. If these recovery figures parallel the average percentage of total recoveries (Table I) it can be assumed that the October flights of 1932 and 1933 were composed of many hundreds of pintail.

Later flights are irregular in time but it is usual for one to be recorded some time during November or December. Mr. R. Luscher has reported that at Boundary Bay, in some years, a migration takes place between Nov. 10 and Nov. 13. However in 1943 the main late flight did not arrive until Nov. 30 and the peak was not reached until Dec. 2. This observer has also recorded large numbers of pintail in this general region as follows: Sept. 24, 1935; Sept. 26, Nov. 10, 1939; Sept. 18, Nov. 11, 1937; Nov. 7, 1940; Oct. 15, 1943.

Sometimes a migration follows the coast line well out to sea and is not observed at mainland points; numerous reports of such seaward migrations off the coast of Vancouver Island have been received.

During October the fields on the lower Fraser valley rarely are flooded so that pintails tend to concentrate on the marshes along the seaward reaches of the river and on the tidal flats of its delta. Later in the season fields may be flooded or they may continue dry. It seems to be a general rule that when the latter condition prevails few pintails appear any distance inland and no large flocks tarry there. This is reflected in the banding data for Station 1, situated 55 miles from the mouth of the Fraser River. The autumn of 1933 was wet and conditions inland favourable so that a total of 734 pintails

was banded between Oct. 16 and Dec. 10. The following figures of numbers banded give some indication of the fluctuations in population during that period: Oct. 16,—5; Oct. 18,—22; Nov. 1,—25; Nov. 12,—28; Nov. 21,—154; Nov. 29,—136; Dec. 7,—26; Dec. 10,—10. Banding totals for this station both in earlier and later years were much smaller (Table I).

It is of interest to trace, so far as possible, the subsequent history of all the pintails banded on a single day. The total of one day's banding possibly may represent a distinct population or, at any rate, an aggregation of birds that arrived in the locality on approximately the same date. Thus of some 350 banded at Station 3 on Oct. 8, 1932, 45 subsequently were recovered as follows: between Oct. 15 and Nov. 8 four were shot within several hundred yards of the banding station, 15 within a radius of 12 miles, two on Sumas Prairie 50 miles east, one each in Whatcom, Snohomish, and Pierce Counties, Wash., two in California, and one was captured and released at Station 1. During the remainder of the year one was shot on the Pitt River, one in Pacific County, Wash., two in Clatsop, two in Multnomah, and one in Tillamook County, Ore. In January, 1933, one was shot at Wagoner, Okla., one in Pacific County and one was found dead in King County, Wash. In the autumn and winter of that year two were captured and released at Station 3 and one was shot in Klamath County, Ore. In the winter of 1934 one was shot at the mouth of the Fraser River, one in Multnomah County, Ore., and one near Suisun, Calif.

The distribution of 96 recoveries from approximately 600 banded at Station 3 on Oct. 8, 1933, was similar. In the first autumn and winter 24 were shot close to the station, 26 within a 12 mile radius, three on the Sumas-Prairie–Chilliwack region, three on the Pitt River, 23 in Washington State, one in Oregon, and three in California. One reported from Oklahoma in March, 1934, probably was shot in the autumn of 1933. In the autumn of 1934 one was retrapped at Station 1 and four were shot, one at the mouth of the Fraser River and three in Washington State. There were two recoveries in 1935, one from the Pitt River and one from Skagit County, Wash. One was shot near the mouth of the Fraser River on Dec. 28, 1937, and another near the same place in January, 1938.

As with the mallard, so with the pintail, a great many of the 749 current recoveries on the Coastal Plain were made during the first few weeks after banding. If the movements of the percentage of banded pintails recovered can be taken as representative of the movements of the population as a whole, it can be said that relatively few remain for long periods on the Coastal Plain. Thus the number taken 6 weeks after banding was 22; 7 wk., 18; 8 wk., 10; 9 wk., 7; 10 wk., 4; 11 wk., 1; 12 wk., 1. These figures are approximate because in connection with 126 recoveries (birds banded at Station 3 and subsequently shot in the immediate vicinity) the exact dates of recovery are not available. However the omission of this number does not affect the conclusion stated.

The 626 current Coastal Plain recoveries of pintails banded at Station 3 were obtained in the following localities, viz.: vicinity of the station, 158; adjacent points near mouth of Fraser River, 217; Station 1 (recorded and released), 19; Sumas–Chilliwack area, 14; Pitt River, 30; points between mouth of Fraser River and Chilliwack, 61; Vancouver Island, 2; Salt Spring Island, 1; Washington State, 124 (Table III).

The distribution of the 116 current Coastal Plain recoveries of pintails banded at Station 1 are as follows: Station 1 (retrapped), 34; five mile radius of Station, 26; Station 3 (recorded and released), 3; points adjacent to Fraser River, 10; Pitt River, 10; points between mouth of Fraser River and Chilliwack, 11; Vancouver Island, 1; Washington State, 21.

Current trap recoveries were not recorded at Station 3 but for Station 1 the details for 34 in this category are available. Ten banded on Nov. 25, 1933, returned to the trap as follows: Dec. 1—3; Dec. 3—3; Dec. 7—3; Dec. 10—3. These records indicate an absence from the locality of from one to two weeks. Other pintails banded earlier in November of the same year and in December, 1938, returned to the trap on the following day or several days later. These recoveries indicate that only a short stay was made in the locality. There is only one record of a pintail returning repeatedly to the trap. This concerns a male banded on Dec. 6, 1939, and returning daily from Dec. 10, 1939, to Jan. 4, 1940.

There are four instances of a westerly flight from the mainland to Vancouver Island and the Gulf Islands, viz.:

Date banded	Locality where recovered	Date recovered
Stn. 3. Nov. 15, 1933	Nanaimo	Dec. 20, 1933
Stn. 3. Nov. 3, 1934	Nanaimo	Dec. 17, 1934
Stn. 1. Nov. 17, 1935	Langford Lake	Jan. 29, 1935
Stn. 3. Nov. 10, 1934	Salt Spring Island	Jan. 20, 1935

No current recoveries have been made from localities north of the Coastal Plain.

Study of the current recovery data as summarized above indicates an irregular movement of population back and forth between points at the mouth of the Fraser River and inland localities as far east as Chilliwack. Few extensive flights are made. There seems little doubt that such movements are correlated with weather conditions as suggested earlier. The data also suggest that large populations remain on the Coastal Plain for relatively short periods and that the territory is not the main wintering ground for pintails.

Later year recoveries on the Coastal Plain, numbering 186, plainly show that populations revisit the same localities in succeeding years (Table III). This is illustrated by the data relating to pintails banded at Station 3 and recovered there, or at places not more than 10 miles distant, in succeeding years. Thus in the first autumn and winter after the year of banding, 35 were

taken and in the years following: 2nd year, 7; 3rd year, 8; 4th year, 3; 5th year, 3; 6th year, 3; 8th year, 1; 9th year, 1.

The records show also that populations return to the present locality, many at approximately the same date a year later. The following records refer to pintails banded at Station 3 and recaptured there the next year.

Date banded	Date recovered	Date banded	Date recovered
Oct. 8, 1932	Dec. 3, 1933	Oct. 8, 1933	Oct. 21, 1934
8	10	14	21
9	3	14	24
9	10	21	21
9	Oct. 24, 1933	29	21
Nov. 6, 1932	Nov. 19, 1933	29	21
6	Dec. 3, 1933	29	21
9	3	29	14
9	3	29	14
12	Oct. 29, 1933	Nov. 5, 1933	17
16	Nov. 19, 1933	19	24
16	Dec. 3, 1933	19	14
26	15	19	14
27	Nov. 26, 1933	26	14
Dec. 18, 1932	Dec. 10, 1933	26	14
18	Nov. 19, 1933	26	21
18	19	Dec. 3, 1933	21
18	Oct. 29, 1933	10	14
20	Dec. 3, 1933		

One bird banded Nov. 26, 1933, and recaptured Oct. 6, 1934, was shot at a place about 10 miles distant in November, 1935.

A pintail banded at Station 1, Nov. 21, 1933, was recaptured there Nov. 1, 1934; another banded Nov. 23, 1934, was recaptured on Feb. 19, 1939.

These data also provide substantial evidence that units of population travel together in successive years. There are six instances of couples, and one of a trio, each of which was banded on the same day and retrapped on the same day a year later. Eight banded between Oct. 8, and Dec. 20, 1932, were all retrapped Dec. 3, 1933; seven banded between Oct. 9 and Dec. 10, 1933, were recovered Oct. 14, 1934, and seven banded between Oct. 14 and Dec. 10, 1933, were retrapped Oct. 21, 1934.

A similar condition noted in the study of mallard banding data led to the conclusion that population units winter and migrate together and probably nest in the same locality. The same conclusion would seem to apply also to the pintails.

There are only three records of winter recoveries north of the Coastal Plain in later years and one from the west coast of Vancouver Island, viz.:

Date banded	Locality where recovered	Date recovered
Stn. 3. Oct. 29, 1933	Port Clements, Q.C.I.	Feb. 12, 1935
Stn. 3. Dec. 10, 1934	Port Clements, Q.C.I.	Dec. 10, 1934
Stn. 1. Nov. 29, 1933	Gifford	Dec. 5, 1939
Stn. 3. Dec. 18, 1932	Ucluelet, V.I.	Jan. 29, 1935

Analysis of current and later year recoveries from localities south of the Coastal Plain (Table IV) indicates that early in the season pintails move south in much greater volume than do mallards. The residual population remains as long as food conditions continue at optimum whereas the mallards with a much wider food range will remain under conditions entirely unsuitable to the pintails.

The total pintail recoveries south of the Coastal Plain is 157, or 14.27%, that of the mallard 232, or 7.91%. The wide, level valleys of interior California are important wintering grounds for pintails but much less so for mallards. There are 40 pintail recoveries and only 11 of mallards from this state. Western Oregon counties provided 44 pintail recoveries, a much larger number relatively than the 57 mallard recoveries from there. The following are selected current recoveries of pintails from localities south of the Coastal Plain. All were banded at Station 3.

Date banded	Locality where recovered	Date recovered
Oct. 8, 1932	Modesta, Calif.	Nov. 2, 1932
9	Levingston, Calif.	9
9	Sauvies Is., Ore.	20
9	Fallon, Nev.	Oct. 23, 1932
Nov. 12	Sauvies Is., Ore.	Nov. 20
Oct. 8, 1933	Colusa Co., Calif.	26, 1933
8	San Francisco Bay, Calif.	12
9	Fenn, Idaho	16
9	Hidalgo, Texas	20
14	Coos Co., Ore.	26
14	Mecca, Calif.	5
14	Yakima, Wash.	Oct. 29, 1933
21	Lincoln Co., Wash.	Nov. 20
Nov. 11	Polk Co., Ore.	Dec. 10
19	Willows, Calif.	13
Oct. 9, 1934	Grant Co., Wash.	Oct. 21, 1934
17	Lincoln Co., Wash.	19
24	Sasaki, Ariz.	Nov. 18
28	Sauvies Is., Ore.	18

It will be noted that in several instances birds had completed a lengthy flight in the relatively short time that elapsed between the time of banding and the time of recovery. The dates definitely limit the time in which the flight was made but for obvious reasons the time could have been much less than indicated.

It will be of value also to record the details of pintails banded in the United States and recovered on the coast region of British Columbia. The particulars are given below.

Banding station	Date banded	Locality where recovered	Date recovered
Burns, Ore.	Nov. 5, 1935	Saanich, V.I.	Autumn, 1942
Burns, Ore.	Oct. 21, 1939	Mouth Fraser River	Sept. 17, 1942
Voltage, Ore.	Mar. 26, 1932	Station 3	Oct. 9, 1932
Irvington, Calif.	Oct. 3, 1934	Quatsino, V.I.	Oct. 3, 1938
Irvington, Calif.	Mar. 8, 1935	Sea Island	Dec. 31, 1939
Bear River, Utah	Sept. 10, 1938	Cloverdale	Nov. 11, 1942
Avery Island, La.	Dec. 19, 1931	Station 1	Oct. 29, 1942
Avery Island, La.	Nov. 2, 1935	Chemainus, V.I.	Jan. 1, 1942
Avery Island, La.	Feb. 5, 1938	Port Clements, Q.C.I.	Feb. 7, 1939

Spring Migration

The pintail flight takes place earlier than that of any other pond duck with the exception of the mallard. The migration of the latter is protracted and composed of numerous small flocks that make short flights sometimes with long intervals between. That involving the mass of the pintail population takes place over a shorter period, usually less than one month, and is conspicuous by reason of the large number of birds constituting the flocks. The earliest flights, and usually the largest, go through in early March. Estimates of numbers at this time on southern Vancouver Island and the Lower Mainland are: Somenos Lake, Vancouver Island, Mar. 3, 1939—150±; Serpentine Flats, Mar. 22, 1935—1500±, Mar. 28, 1935—120±; Matsqui, Mar. 27, 1935—3000±, Mar. 28, 1935—126. Flights composed of small flocks continue through April and a few stragglers are still present in early May.

Station 1 was in operation in spring during several years but except for the year 1939 captured only an occasional pintail. In that year the trap was operated from Jan. 1 to April 19 and in the period Feb. 2 to Mar. 17, a total of 58 was trapped. Through this period the migration probably was at its height. Station 2, operated from February to April in 1933, 1934, and 1935, captured only 13 in the three seasons. Station 3 was closed in spring.

The most northerly records available concern the late migrations of small flocks on the Queen Charlotte Islands: Massett, April 30, 1920—24; McClinton Creek, April 20 to April 30, 1935—60±, May 11, 1935—58.

These migrations follow the coastline to nesting grounds on the Behring Sea and Arctic Ocean coasts of Alaska and along many of the Alaskan rivers. An interior migration is discussed later in this paper.

Summer

There is only one definite record of the pintail nesting on the coast of British Columbia, viz.: a female and four downy young seen at Terra Nova, Lulu Island, June 17, 1942 (Racey and Luscher). Nevertheless small numbers are seen there in summer as at Comox, Vancouver Island, June 6, 1926—4; June 15, 1924—10 (Pearse) and Burnaby Lake, May 27, 1942—3 (Cowan). The presence of non-breeding pond duck populations far from any known nesting ground is of common occurrence. None has been the subject of adequate study but it can be conjectured that they are derived largely from

those individuals that, because of some physiological deterrent, are laggard in migration, from others that have not reached sexual maturity, and, later in the summer, from adult males that have nested elsewhere and shortly afterwards moved from the nesting ground. This is not to discount the possibility that small numbers of pintails regularly nest along the coast.

Thirty-three spring to autumn recoveries from Alaska in a total of 48 from north of the Coastal Plain is strong presumptive evidence that this northern territory is the most important nesting ground and that the territory occupied is extensive. Bands have been recovered along many of the rivers, in the interior and on the coasts of Behring Sea and the Arctic Ocean. The localities represented and the number of recoveries from each are listed below in alphabetical order: Akularak Mission, 1; Anchorage, 1; Becharof Lake, 1; Bethel, 1; Colville, 1; Cordova, 3; Diamond, 1; Egegik, 2; Fairbanks, 1; Gakona, 1; Iliamna, 1; Kantishna River, 1; Kobuk River, 2; Koyuk River, 1; Koyukuk River, 1; Kuskokwim, 1; Lower Yukon, 2; Marshall, 1; Naknik, 2; Nootak, 1; Norton Bay, 1; Ophir, 1; Petersburg, 1; Pilgrim's Springs, 1; Quinhagak, 1; Skaktoolek, 1; Tatlin, 1; Unalakeet, 1.

Interior Region

Spring Migration

There appear to be two main travelled routes to the Interior Plateau, one, used in some years at least by the largest number of birds, follows the Fraser–Thompson, the other the Columbia–Okanagan River system. There seem also to be two main flights, or mass movements, in the time sense, one appearing late in March, the other in April. These usually are separated by an interval of two or three weeks and each has its particular resting places en route occupied for varying lengths of time that may be governed by weather conditions. Those using the Fraser–Thompson route concentrate on a number of ponds near Kamloops. Migration dates for this place are: Mar. 21, 1939—800±; April 7, 1939—101; Mar. 30, 1940—680±; April 23, 1940—100. Pintails travelling the Columbia–Okanagan route have been recorded as follows: Glenmore, April 23, 1938—750±; April 18, 1939—700±; April 14, 1940—56±; Okanagan Landing, Mar. 28, 1937—83; Rawlings Lake, April 24, 1937—150±.

Farther north these two flights meet, each contributing its quota to the stream of migration that crosses the Cariboo Parklands. It is not known whether or not this migration is augmented by other pintail flocks reaching the interior from points on the coast north of the Fraser River. The birds move northward in haste keeping abreast of, or advancing before, the break-up of the ice. In some years large numbers reach the Chilcotin country quite early in the spring. Thus at Chezacut lake in 1940 six were seen on Mar. 19; by March 25 approximately 1500 had arrived and by April 6 all but 200± had left (Shillaker). The latest records of transient flocks in the Cariboo region are: Little White Lake, April 29, 1938—62; 103 Mile Lake, April 21, 1941—80; 72 Mile Lake, Cariboo, April 29, 1943—73, 120.

By the first week in May all but a few of the transients have moved north. Thus on May 9, 1942, only three lots numbering 4, 6, and 14 respectively were seen on the lakes close to the highway between Kamloops and Lac La Hache.

There is another important flight through the province by way of the Rocky Mountain Trench. W. B. Johnstone reports seeing "thousands" in the East Kootenay district between Mar. 24 and Mar. 26, 1940, inclusive. This undoubtedly was the migration peak for that year. On Mar. 25, 1941, approximately 100 were counted by him on Columbia Lake; his records for other years from 1937 to 1943 refer to small numbers observed in April. It is not known whence this flight comes nor where it goes. None of the five thousand and more pintails banded in the Province has been recovered in the East Kootenay which suggests the possibility that the pintails that pass through there and those visiting western British Columbia belong to different populations.

More northern records of the spring migration refer to Tetana Lake where in 1938 pintails were first seen on April 10 and became common on April 28 (Fletcher), to Swan Lake, Peace River, where 25 were counted on May 6, 1938, and the last was seen on May 30 (2), to Atlin where the earliest date of arrival is April 23, 1934 (7).

The only spring recovery of a banded pintail in interior British Columbia was made 200 miles north of Hazelton in 1935. Some of those recovered in Alaska, more particularly those from the interior of the territory, may have travelled by the interior route but of this there is no proof.

None of the eight Alberta recoveries provides evidence of a direct flight from the wintering grounds on the Pacific Coast but that such a migration occurs, by way of the Interior Plateau and the Yellowhead Pass, seems probable. However all that the data reveal is that pintails banded on the coast of British Columbia have later been recovered in Alberta. This applies also to the single recovery from Saskatchewan. The particulars are given below.

Banding station	Date banded	Locality where recovered	Date recovered
Station 3	Oct. 8, 1933	Wostok, Alta.	Oct. 23, 1935
3	Oct. 8, 1933	Coaldale, Alta.	Nov. 14, 1934
3	Oct. 21, 1933	Ft. Vermilion, Alta.	May 1934
3	Oct. 29, 1933	Blackfalds, Alta.	Sept. 20, 1935
3	Nov. 15, 1933	Wetaskiwin, Alta.	Sept. 17, 1934
3	Dec. 3, 1933	Olds, Alta.	Autumn, 1934
3	Dec. 10, 1933	Bruce, Alta.	May, 2, 1935
1	Nov. 29, 1933	Connor Creek, Alta.	May, 1943
3	Nov. 26, 1933	Mendham, Sask.	June, 1935

Autumn Migration

In the interior as on the coast there are late summer and early autumn migrations, the earliest composed largely of eclipse males and non-breeding

females. On the small lakes near Kamloops records of this early movement were made as follows: June 27, 1935, flock of 13 males in eclipse and 11 females; June 12, 1939, 12 males in eclipse. A flock of 75 eclipse males on McKinley Lake, Cariboo, July 20, 1938, and one of 40 on Mirage Lake, Cariboo, Aug. 1, 1938, are other examples.

Unlike the spring migrations these early southern movements are not conspicuous and it seems probable that long flights, interrupted by few periods of rest, are the rule. It is likely also that the early inland migrations contribute to the August concentrations on the Oregon marshes referred to earlier.

Later migrations are in greater volume but the numbers of birds that tarry on suitable feeding lakes and marshes en route vary considerably as indicated by the following counts of maximum numbers seen, viz.: Chezacut Lake, Oct. 8, 1940—2000±, Sept. 29, 1941—150±, Oct. 28, 1941—100± (Shillaker); Swan Lake, Okanagan, Sept. 20, 1932—250±, Sept. 30, 1933—400±, Oct. 4, 1934—300±, Oct. 1, 1937—140, Sept. 30, 1939—10, Oct. 15, 1940—35, Oct. 30, 1942—50, Nov. 27, 1942—50, Aug. 24, 1943—50±, Sept. 23, 1943—60±.

There are five records of birds banded on the coast of British Columbia and recovered in autumn in the southern interior, the particulars being as follows:

Banding station	Date banded	Locality where recovered	Date recovered
Station 1	Nov. 25, 1933	Kamloops	Sept. 21, 1934
1	Nov. 27, 1933	Quilchena	Sept. 18, 1934
1	Dec. 2, 1934	Savona	Nov. 1, 1935
3	Oct. 3, 1932	Red Pass	Oct. 8, 1935
3	Nov. 19, 1933	Merritt	Oct. 28, 1934

Twenty-four pintails were banded in the late summer and autumn at Buffalo Lake, Cariboo, Station 5, during the two seasons this station was operated, a number insufficient to provide much information regarding the interior migration. Of the six recoveries three were made locally shortly after banding and three were made in the United States. The details of the latter are:

Date banded	Locality where recovered	Date recovered
Oct. 7, 1933	Portland, Ore.	Dec. 3, 1934
Oct. 12, 1933	Winnemucca Lake, Nev.	Oct. 29, 1933
Oct. 12, 1933	Grandview, Wash.	Nov. 4, 1933

One banded at Vaseaux Lake, Nov. 6, 1931, was shot at Oroville, Wash. on Nov. 19, 1941. This was the only recovery from pintails banded at Station 4.

Four pintails banded in the United States were recovered in the interior of British Columbia, the particulars being:

Locality banded	Date banded	Locality where recovered	Date recovered
Moiese, Mont.	Sept. 26, 1927	Kamloops	Oct. 4, 1928
Burns, Ore.	Sept. 2, 1936	Vanderhoof	Sept. 27, 1938
Burns, Ore.	Sept. 13, 1937	Vernon	Oct., 1937
San Diego, Calif.	Jan. 29, 1938	Anahim Lake	April, 1942

The record of movement from Burns, Ore., to Vernon, B.C., indicating a lengthy autumn flight from south to north, is the sole example of its kind in the pintail banding data and cannot readily be explained.

The total of these data while not sufficient in itself to form the basis of any conclusion regarding the direction of migratory movements in the interior does serve to relate these with wintering grounds both on the littoral and in the interior of Pacific Coast States.

Small numbers of pintails remain on the lakes in the interior until the feeding grounds are frozen in late November or early December. There are a few records of birds wintering, one being a male collected at Okanagan Landing, Jan. 5, 1916.

Reproduction

A small population of pintails nests in the Kamloops district and northward. In the Cariboo Parklands the pintail is the third commonest pond duck, the first and second being the mallard and the baldpate, *Mareca americana*, respectively. In the East Kootenay it is reported to breed regularly in the vicinity of Cranbrook and at Columbia Lake, this statement being supported by the following evidence, viz.: Cranbrook slough, May 24, 1939, one nest with seven eggs, another with nine; July 1, 1937, female with six young; Columbia Lake, July 10, 1938, four females with broods; Aug. 2, 1940, female with brood of large young; Aug. 9, 1942, female with large young (Johnstone). None has been reported as nesting in the Okanagan Valley nor in the Peace River Parklands (2).

A favourite nesting terrain in the Cariboo Parklands may be described briefly as one of open, rolling grassland broken here and there by brushy thickets and aspen copses and with *Carex* and *Scirpus* sloughs, or ponds of various types, in many of the depressions. A partly open flat or slope giving upon one of the many marshy or hard-shored lakes is another type of nesting country.

By late April most of the transients have left and it is usual to see the remainder, the nesting population, gathered in pairs or in small groups on the ponds and lake shores of the nesting ground. For long periods in the daylight hours these prenesting pintails rest and preen their plumage as they stand near the water's edge or drift idly on its surface. There are brisk

intervals of feeding and brief recurrences of courtship display. No high excitement marks the pintail courtship. The male assumes various postures that display the long tail or the white underparts and there is play with the long graceful neck. One or more males with necks extended vertically may glide slowly in and out amongst a flock on the water; one rushes over the water towards a female; she takes wing with the male in quick pursuit. There follows a swift courtship-flight, now high in the air now low over the ground or over the water, the female in the lead twisting and turning, the male close behind. Perhaps one or more males may join the couple, or a small group may take flight in pursuit of several females. In these graceful manoeuvres the birds travel at great speed to which the whistle of wings makes an appropriate accompaniment. At the conclusion of the flight they glide to the water on down-curved wings, their feet out-thrust to brake the tumultous descent as the ducks strike the water and are impelled along its surface. Such flights performed by a male and female or by a group may commence suddenly without preliminary display or introduction.

The courtship time is short and few of its manifestations take place after ducks are paired; usually only a close companionship identifies their sexual relationship. During May it is still common to see them loafing on the beaches or feeding in the shallows. Or they may stand in some patch of flooded grass or sedge where the long necks of the males are visible above the vegetation that provides sufficient cover to hide the smaller females.

There does not appear to be much competition for territories—i.e. the pond, slough, or portion of lake shore, usually some distance from the nest, that is occupied by a nesting pair. Where several pairs use the same slough or section of lake shore no hostility between the males has been observed.

The following are examples of pair-behaviour under observation: a pair standing close together on top of a large boulder at the edge of a pond, the male preening, the female suspicious of danger has her neck extended at full length. Both fly to the water and a few minutes later the female flies again, perhaps to her nest. In the next instance the nest is situated close to the shore of a marshy pond; the male is swimming nervously back and forth on the pond; the female, after covering the eggs, leaves the nest and joins the male, then both rise and upon completing a short flight return to the pond.

The males awaiting the arrival of their mates from the nest usually are inactive, drifting on the water or often standing half concealed in the shore-line grass. Often two or more may be together but at this time they do not commonly associate with other species of ducks that may be present. As the laying period reaches its end and the absences of the females from the territories become longer this fraternizing of males increases.

Nesting

Pintails seem to evince preference for a dry nest site; it may be close to water or some considerable distance away. The number of eggs in a nest

varies from five to nine, the average-size clutch being eight. The following description of nests and nest sites covers their variation as observed in the Cariboo Parklands.

"Sorensen" Lake, May 20, 1942. Habitat, small thicket of aspen and lodgepole pine on open hillside 100 ft. above and 500 ft. inland from lake shore; site, under edge of prostrate juniper branch at edge of thicket; nest of fine grass and a large quantity of down—seven eggs.

"Sorensen" Lake, May 20, 1942. Habitat, boulder area along high-water mark of lake; site, between two boulders measuring approximately 12 in. in length and 6 in. in height; nest of fine grass and large quantity of down, the concealment, chiefly *Potentilla anserina*, slight—eight eggs (Fig. 3).

Slough 1, Springhouse, May 21, 1942. Habitat, dry growth of previous year hard-stem bulrush on slough margin; site, centre of thick bulrush clump 10 ft. from water's edge; nest of shredded bulrush stems and large amount of down; a well trodden runway leading from nest to edge of slough—eight eggs (Fig. 2).

Westwick Lake, June 3, 1937. Habitat, grassy slope to lake; site, in short grass 100 ft. from water; nest of fine grass and down—seven eggs.

Horse Lake, May 28, 1937. Habitat, partly flooded wild hay meadow and willow swamp; site, on dry ground close to edge of willow copse; nest of down with 2 in. rim above ground that could readily be seen 40 yd. away; eight eggs advanced in incubation.

Pond, Clinton, June 7, 1937. Habitat, large, marshy pond with aspen and brush-covered slope on one side; site, on patch of green *Carex*; nest of dry, desiccated *Carex* stems mixed with small amount of down; four eggs. When the eggs were covered the nest resembled a natural accumulation of marsh debris and thus was inconspicuous.

Slough 1, Springhouse, June 11, 1941. Habitat, 10-acre slough surrounded by *Scirpus* in hayland; site, dry, open situation amongst short grass and *Potentilla anserina* 250 ft. from slough edge; nest of vegetable debris and small amount of down—three eggs.

Slough 1, Springhouse, June 12, 1941. Habitat same; site, between two stones in boulder area along high-water mark 120 ft. from water's edge; nest of dry grass and a little down—six eggs.

Boitano Lake, Springhouse, June 10, 1941. Habitat, dry hillside 400 yd. from lake shore; site, in short grass and windflower; nest of dry grass and large quantity of down, was well concealed in this open situation—nine eggs.

Slough, Springhouse, June 17, 1941. Habitat, *Carex* meadow surrounding two-acre slough with the surface covered by *Polygonum amphibium*; site, 120 ft. from water's edge in thick clump of *Carex* 18 in. high; nest 8 in. in diameter, of dry *Carex*, moss, and down—six eggs.

The female pintail, before leaving the nest to bathe and feed as she does each day, almost invariably covers the eggs with part of the nest material.

She may wait to do this even when departure is a fear reaction. The nest may consist of dry grass, some kind of vegetable debris mixed with down, or down exclusively, but whatever the material it usually proves effective in concealing the eggs. If during the early days of incubation a female is disturbed by the sight or sound of a person approaching she may slip away unobserved long before the person has reached the vicinity of the nest. This reaction to threatened danger lessens as the days of incubation pass until near its end she may not flush until the person approaching is within a few yards.

Nests frequently are in exposed positions and being so would seem more than commonly vulnerable to crow predation. Undoubtedly this, as well as other forms of predation, does occur but precise evidence was not obtained. Of the 12 nests under observation in this study one with six eggs was deserted three days after being found; another containing three eggs on June 11 was empty when next visited on June 19—what removed the eggs was not determined. The histories of two others were followed until the eggs hatched, and the remainder were visited on three to six successive days. None of these while under observation was disturbed by predators.

One nest containing nine eggs and situated in an exposed position on a bare hillside 400 yd. distant from a lake, was found on June 10, 1941, by flushing the female. On June 12 and June 13, she was not seen to leave and it took some time to find the nest, so well did the grass and down covering the eggs merge with the bare surroundings. Thereafter it was visited daily between 7.30 and 9.00 a.m. until June 23. Until June 21 the duck flushed at from 50 to 100 yd. and on every occasion save one the eggs were covered. On June 23 she allowed an approach within 10 ft. before leaving and it was evident the eggs were on the point of hatching. An examination of the egg shells in the nest two weeks later proved the hatching to have been successfully accomplished. Both ducks and eggs had been exposed to considerable hazard during all this time. Cattle grazed and bedded down close to the nest and as the days passed piles of cow-dung accumulated there; crows walked about or flew back and forth across the hillside and were never absent from a row of cottonwoods along the lake shore below. Once as the pintail left her nest to sweep downhill and make a wide circle before alighting on the lake, a prairie falcon, *Falco mexicanus*, struck and missed and she hurled herself down to the water with an increased burst of speed.

Another nest under observation at Horse Lake contained seven recently hatched young on May 28, 1937. When approached the female flew from the nest and dropped to the ground again 20 ft. away. Obviously reluctant to leave the vicinity of the young she made another short flight, then disappeared in a nearby sedge marsh. On previous days when disturbed she had flown several hundred yards before alighting. Meanwhile the young moved into a small depression under a dead willow 15 ft. from the nest and huddled together there. This nest also was exposed to view and the sitting female

FIG. 2. *Nest and eight eggs of pintail, Springhouse, B.C., May 21, 1942.*
FIG. 3. *Nest and eight eggs of pintail, "Sorensen" Lake, B.C., May 20, 1942.*

was easily visible. Crows that nested on adjacent aspens frequently hunted for food on the ground within a few yards of the sitting bird.

Behaviour of Females with Young

The female pintail is active and skilful in defence of its gray-brown young. On the day they hatch she leads them from the sometimes conspicuous nest to the safety of meadow or marsh cover and this is home for the first six flightless weeks of their young lives. Weed-covered ponds and floating weed-masses on larger bodies of water are visited because of the insect food found there but the time spent away from concealing cover is short and they retreat to it at the first alarm.

While concealment of the young is the chief defence employed by the female the arrival of man in her vicinity brings forth an immediate and vigorous response. Thus on June 15, 1941, at Springhouse one disturbed near a small slough ran through the short prairie grass dragging her wings or beating them against the ground. After running so for about 50 yd. she flew to the nearby slough. Meanwhile two of the brood had been found hiding in the grass. She returned to their vicinity in a few minutes, quacking softly and evidently calling them to her. In the days following, this family was encountered numerous times and no apparent lessening of the female's solicitude for the young was observed as they grew older. Once when flushed at a distance of about 10 ft. she dropped down again almost at once, then, with belly against the ground and wings extended, shuffled through the short grass and mud to the water's edge. The effort to distract attention from the young took other forms also, the most common being a succession of short flights that barely cleared the grass tops but followed a nearly straight course. On July 8, the young were half grown and on this day when the female left them they were discovered crowded into a small space below a grass tussock hiding just as small downy young do in the same circumstances. On this occasion the female ran through the grass, flew over it, or swam along the edge of the slough keeping in advance of the observer for a quarter mile or so. Halfway down the slough a female mallard, also with young concealed in the grass, fluttered out from the shore and joined the pintail. They remained together making short flights and quacking excitedly.

Several other examples show the variety in the behaviour-pattern of females with young.

June 8, 1938. Two members of a brood about 10 days old ran down an open, grassy hillside that sloped to a small pond. The female circled low over them several times until finally they hid themselves in the grass and she alighted on the pond.

July 9, 1938. A female with brood concealed in a marsh bordering Westwick Lake rose from the shore and, making short flights with intervals between on the water, accompanied a canoe until it was taken ashore at a place half a mile distant.

June 7, 1940. A female with brood of six, three to four weeks old, was swimming across 103 Mile Lake which is about one-quarter mile wide. When approached by canoe she flew ahead of the brood for 30 ft. or so and waited there until the young swam to her. She then led them towards shore.

July 2, 1940. A female on the same lake with six young about two weeks old left them, when she became alarmed, and flew to a distant part of the lake.

The following are the earliest records for young: Horse Lake, May 31, 1937; Slough near Kamloops, June 8, 1938; Elliott Lake, June 13, 1942. The average number in 29 broods was 6.2.

It is believed that some young pintails maintain the brood formation during the autumn migration. The evidence for this is that at Swan Lake, Okanagan, in late August or in September, groups of three to five birds of the year have been observed asleep on the water—as if they had just recently completed a long flight. Usually such birds are quite unwary as when a brood of five alighted amongst a hunter's decoy ducks.

Behaviour of Postbreeding Males

The pronounced inactivity of breeding males on their territories during the laying season ends somewhat abruptly when incubation commences. They become restless, move from one pond to another, join other males or attach themselves temporarily to any pond ducks, mated or otherwise, that may be present. They are wilder than formerly and if approached take wing before mated birds on the same waters do. Nesting female pintails that come to the ponds to bathe and feed do not excite them. Thus at "Sorensen" Lake on May 23, 1942, a female flew from her nest, situated 100 ft. or so from the water, and alighted on the water about 50 ft. from a group of three males. One of these swam slowly towards her but made no movement suggesting a sexual interest. A few minutes later these four, as well as two males and a female that had been concealed in nearby rushes, flew off together.

Postbreeding males, after deserting their territories, may remain in the general vicinity for two weeks or so. Thus in 1942 at Springhouse, where a pintail population on a series of small ponds and sloughs was being studied, a postbreeding group of males increased from two on May 18 to seven on May 28. At the same place in 1941, when six nests and territories were under observation, the male of one pair was last seen on his territory (visited each day by the female) on June 8, the male of another pair on June 10. Males were not seen on the four other territories and presumably had left them prior to the beginning of the study on June 4. None appeared anywhere in the vicinity between June 12 and June 16 but on the following day a flock of nine males and nine females alighted on one of the several sloughs.

Early in June males began to show signs of the eclipse plumage. Thus on June 9, 1938, all the members of a flock numbering 17 were noticeably darker than spring males by reason of the dark eclipse feathers appearing on their white underparts. This was so also with the nine males observed on June 17, 1941, and referred to above. By early July some have progressed to the point

in the moult where it is difficult to distinguish them by their coloration from females.

It seems evident that the early migrations take place prior to the renewal of flight feathers and that this portion of the moult is completed in marshes far to the south. A flock of some 75, chiefly eclipse males associated with a larger number of eclipse mallards on an open "soda lake" (McKinley Lake), June 20, 1938, were identified as transients. They were exceedingly restless and took flight if approached within 200 yd.

It is not known whether all or only part of the male population moves out after breeding. All through the summer small numbers of male pintails frequent the marshes in the Cariboo Parklands but whether these represent parts of local nesting populations or are recruited from more northern nesting grounds or whether they represent units of both cannot very well be determined. None in a flightless condition has been observed but undoubtedly those remaining through August have passed through this period and renewed their flight feathers.

Sex Ratio

A total of 2254 pintails, with sex recorded, was banded in British Columbia from 1923 to 1940 (Table I). Of these 759, or 34%, were male and 1495, or 66%, female. In each banding period, with a few exceptions involving small numbers of birds, the total of females captured exceeded the total of males. The daily records show that females exceeded males on 84 days, males exceeded females on 43 days and on nine days the numbers of males and females were equal. Where males exceeded females usually the totals of both were small and on some days only one or two males, and no females, were trapped. The largest figures showing excess of males over females are $\frac{14}{8}, \frac{36}{24}, \frac{34}{13}, \frac{26}{15}$.

As on certain days the number of males taken exceeded the number of females it cannot be assumed that the general preponderance of females was due to their being less wary than males and hence most likely to enter the traps.

These figures suggest a considerable sexual unbalance. So also does the fact that postbreeding flocks on the nesting ground in June and July contain a large proportion, in some instances 30 to 40%, of females that presumably have not bred. On the other hand field observations in spring do not bear out the sexual disproportion suggested by this fact and by the banding data. Indeed what precise figures are available show that spring flocks sometimes contain a greater number of males than females. However the possibility of some sexual segregation in migration is to be recognized. Banding records of pintails shot, which include sex data, number 553, of which 199, or 36% refer to males and 354, or 64%, to females.

As none of these data is entirely satisfactory and because of the variables involved it is not practicable at this time to estimate the sex ratio.

Food and Feeding Habits

The food range of the pintail is more restricted than that of the mallard as has been pointed out. When feeding on rain-soaked or flooded fields both eat the same foods commonly found there, namely waste grain, grasses, and weed seeds. The pintail, however, has not been observed feeding on potatoes in the field as mallards frequently do. Neither has it acquired the habit of eating grain on dry stubble. So far as is known the mallard is the only American duck that has learned to feed extensively on dry grain in places where water is not available to moisten it.

In company usually with other pond ducks pintails sometimes cause damage to young clover and other forage crops by feeding on the plants when they are submerged by flood water or when their roots have become loosened by heavy rains. Later the receding waters expose dark, bare patches amid the prevailing green expanse of crop where ducks, feeding intensively, have pulled out and trampled the plants. Many cultivated fields hold impermanent ponds in their depressions and these serve to attract pond ducks often in large numbers. Such places are focal points for feeding and the areas of crop around them are damaged in much greater proportion than are those on higher points of the field.

In the marshes the pintail consumes the seeds of various plant groups including rushes, sedges, pondweeds, and many others. To a lesser extent the larvae of aquatic insects, molluscs, and small crustaceans are eaten. The sea shore is marginal feeding ground used extensively only when heavy frost has sealed the freshwater area. Pintails have not been observed feeding on salmon eggs or on the flesh of dead salmon.

The contents of 28 stomachs from specimens collected in the interior east of the Cascade Mountain Range and of 20 from localities along the southern coast have been studied. A summary of the results follows.

Food of Downy Young

The stomachs and gullets of three downy young taken at 103 Mile Lake, Cariboo, July 2, 1942, were extended with damselfly nymphs, *Enallagma* sp.; one had eaten 21+, another 25, and the third 45+. Two also contained one seed each of the pondweeds *Potamogeton pectinatus* and *P. pusillus*, in each representing less than 1% of the total contents.

Food of Adults, Interior Region

One from Watson Lake, Cariboo, collected Sept. 25, 1942, contained 190 seeds of bulrush, *Scirpus acutus* and five Corixidae. One taken on Okanagan Lake, Jan. 5, 1916, had eaten a quantity of sedge fibres and rootlets, 18 seeds of bulrush, *Scirpus americanus*, a few caddis larvae, molluscs, and Bryozoa. Another from a pond in the same region contained the following seeds, viz.: *Potamogeton pectinatus*, 140; *Scirpus americanus*, 150; *Myriophyllum* sp., 2; *Cyperus* sp., 2; *Ranunculus* sp., 1; *Labiatae* sp., 17, together with a large bulk, 68%, of sedge and grass fibres.

The contents of 22 stomachs from Swan Lake, Okanagan, September—10, October—8, November—4 are summarized in the succeeding section.

Crustaceans. Two contained amphipods that in one represented 25% and the other 27% of the contents. Both *Hyalella azteca* and *Gammarus limnaeus* were identified.

Aquatic insects. The gullet and proventriculus of one specimen contained a mass of approximately 300 blood worms, Chironomidae, this item representing 90% of the food present; another had eaten 20 larvae of the same species. In a third were nine whole corixids and fragments of at least 20 others, the total constituting 80% of the contents. This item in smaller amounts was present in four other stomachs. In another were a cranefly larva, Tipulidae, four beetle larvae of which three were *Haliplus* sp., and an adult member of the Gyrinidae, the total being 6% of the stomach contents. Small amounts of insect fragments were present in two other specimens.

Molluscs. Gastropod fragments were present as a minor item in four stomachs and represented half of the contents in another. All were small specimens, two sufficiently intact to be identified as *Planorbis* sp.

Algae. The oöspores of muskgrass, *Chara* sp., were found in eight stomachs, in two representing 60% and in another 70% of the total food. Terminal branches of muskgrass occurred twice, in one constituting 42% of the food material in a full stomach.

Bulrush seeds. The achenes of *Scirpus acutus* constituted the food item of greatest importance, occurring in all but one specimen, with a total percentage volume of 46.28.

Miscellaneous seeds. The species of most frequent occurrence and in the largest volume was *Potamogeton pectinatus*; *Myriophyllum spicatum* was second in importance. Other species identified were *Potamogeton pusillus, P. heterophyllus, P. foliosus, Rumex maritimus, Zanichellia palustris, Eleocharis palustris, Polygonum (amphibium?).* Seeds in this category composed 19.27% of the total volume.

Miscellaneous vegetation. This includes one record of leaves and branches, another of tubers, from the pondweed *Potamogeton pectinatus.* Two others consisted of comminuted vegetation in small amounts.

Food of Adults, Coast Region

Localities represented on the coast region, with the month of collection and the number of specimens examined, are: Boundary Bay, December—1; Cloverdale, December—1; Sea Island and Lulu Island, February—1, October—5, December—2; Pitt Meadows, December—3; Cowichan Flats, January—3; Nanaimo Flats, January—2; Quennell Lake, January—2.

Crustaceans. A specimen from Boundary Bay contained remains of several marine amphipods and in another, from Nanaimo Flats, were two shore crabs, *Hemigrapsus nudus,* with carapace measurements of 5 and 12 mm.

respectively. These, together with other crab fragments, composed 70% of the total stomach contents.

Molluscs. A specimen at Nanaimo Flats in January contained 50+ *Littorina scutulata* Ild., and these with additional broken mollusc shells made up 29% of the contents; in another nearly empty stomach, from Quennell Lake, were two whole gastropods of the same species and fragments of others. The third, from Cowichan Flats, contained a small amount of shell fragments that represented 5% of the total stomach contents.

Seeds. All of the 20 stomachs contained seeds in varying amounts and these were the exclusive item in nine from mainland points. Bindweed, *Polygonum convolvulus*, made up 70 to 100% of the total food in four well-filled stomachs and was present as a smaller item in another. Other species of Polygonaceae occurred 11 times, representing in one stomach 75% and in each of two others 50% of the food eaten. Cultivated oats were present in five, clover seed in two, and seeds of various other plant species, chiefly aquatics, in nine specimens (Table V).

Miscellaneous vegetation. In this category are included four records of grass leaves and stems and six records of unidentified vegetable debris.

TABLE V

FREQUENCY OCCURRENCE OF IDENTIFIED FOOD ITEMS IN 46 PINTAIL STOMACHS

Amphipod, unidentified marine form		1
Amphipod, *Hyalella azteca*		1
Amphipod, *Gammarus limnaeus*		1
Shore crab, *Hemigrapsus nudus*		1
Damselflies, *Enallagma* sp.	Nymph	3
Water boatman, *Arctocorixa laevigata* (Uhles)	Adult	4
Caddis	Larva	1
Micro-trichoptera	Larva	1
Beetle, terrestrial	Adult	1
Beetle, aquatic, *Haliplus leechi* Wallis	Adult	1
Beetle, *Haliplus* sp.	Larva	1
Beetle, Gyrinidae	Adult	1
Crane fly, Tipulidae	Larva	1
Blood worm, Chironomidae	Larva	2
Snail, *Littorina scutulata* Ild.		2
Snail, unidentified marine form		2
Snail, *Planorbis* sp.		2
Snail, unidentified freshwater forms		4
Bryozoa	Statoblasts	1
Muskgrass, *Chara* sp.	Branches	2
Muskgrass, *Chara* sp.	Oöspores	6
Bur-reed, *Sparganium* sp.	Seeds	2
Pondweeds, *Potamogeton heterophyllus*	Seeds	3
Potamogeton pusillus	Seeds	4
Potamogeton foliosus	Seeds	1
Potamogeton pectinatus	Seeds	13
Potamogeton pectinatus	Tubers, branches	2
Horned pondweed, *Zannichellia palustris*	Seeds	1
Foxtail grass, *Alopecurus* sp.	Seeds	1
Velvet grass, *Holcus lanatus*	Seeds	1
Grass, Gramineae	Leaves, stems	5
Cultivated wheat, *Triticum vulgare*	Seeds	4
Saltgrass, *Distichlis* sp.	Seeds	3
Brome grass, *Bromus* sp.	Seeds	2

TABLE V—*Concluded*

FREQUENCY OCCURRENCE OF IDENTIFIED FOOD ITEMS IN 46 PINTAIL STOMACHS—*Concluded*

Sedge, *Carex vesicaria*	Seeds	1
Sedge, *Carex* sp.	Seeds	4
Sedge, *Carex* sp.	Fibres, rootlets	2
Bulrush, *Scirpus acutus*	Seeds	27
Bulrush, *Scirpus americanus*	Seeds	6
Spike rush, *Eleocharis palustris*	Seeds	3
Dock, *Rumex maritimus*	Fruits	1
Buttercup, *Ranunculus* sp.	Seeds	1
Bindweed, *Polygonum convolvulus*	Seeds	5
Smartweed, *Polygonum (amphibium?)*	Seeds	5
Polygonum hydropiper	Seeds	4
Polygonum persicaria	Seeds	7
Polygonum hydropiperoides	Seeds	2
Orach, *Atriplex* sp.	Seeds	2
Ball mustard, *Neslia paniculata*	Seeds	1
Water milfoil, *Myriophyllum spicatum*	Seeds	9
Hornwort, *Ceratophyllum demersum*	Seeds	1
Buckbean, *Menyanthes trifoliata*	Seeds	1
Self-heal, *Prunella vulgaris*	Seeds	1
Plantain, *Plantago major*	Seeds	1
Plantain, *Plantago* sp.	Seeds	2
Mint, Labiatae	Seeds	1
Hop clover, *Trifolium dubium*	Seeds	1
White clover, *Trifolium repens*	Seeds	2
Red clover, *Trifolium pratense*	Seeds	1

TABLE VI

FOOD OF 45 ADULT PINTAILS, PERCENTAGE OF TOTAL VOLUME

Locality and number of specimens		Crustaceans	Insects	Molluscs	Chara oöspores	Polygonum seeds	Scirpus seeds	Misc. seeds	Misc. vegetation	Potamogeton seeds	Cultivated wheat
Watson Lake	1		5.00				95.00				
Swan Lake, Okanagan	22	2.30	11.31	3.44	13.90	9.77	46.28	9.50	3.50		
Pond, Okanagan	1							62.00	38.00		
Boundary Bay	1	1.00				10.00		9.00		80.00	
Cloverdale	1					50.00			50.00		
Pitt Meadows	3							33.66	21.35	41.66	3.33
Sea Island, Lulu Island	8					53.38	15.38	.13	2.13	.25	28.73
Cowichan Flats	3			1.64		5.00		38.36	40.00	15.00	
Nanaimo Flats	2										
Quennel Lake	2			45.00				50.00	5.00		
Okanagan Lake	1		5.00	2.00			3.00		90.00		

Food Summary

Three downy young from the Cariboo region had fed upon damselfly nymphs almost exclusively, their stomachs and gullets being distended with this food. The diet of 25 adults from the interior was composed of 83% vegetable matter and 17% animal matter. In the former, seeds of *Scirpus acutus* were first, and seeds of *Potamogeton pectinatus* and other aquatics

second in importance. Muskgrass also had been taken. The animal constituent was composed of aquatic insect larvae, mollusca, and amphipods, listed in the order of their percentage of total volume. On the mainland coast, seeds were the most prominent item in the contents of 13 stomachs and amongst them those of the Polygonaceae, particularly *Polygonum convolvulus*, were first in times of occurrence and percentage of total volume. Seeds of cultivated grains, chiefly oats, also were eaten in substantial amounts. Four specimens that had visited a sea-shore habitat contained marine molluscs and crustaceans.

Economic Status

The pintail is destructive of forage crops for a short time in each year over a limited area of British Columbia. In no other way does it conflict with human interests. What has been said of the mallard concerning its economic value in terms of a capital investment that derives all or part of its revenue from hunting, of recreational value, and of value as food, applies equally, although in a less degree, to the pintail. The destruction caused to crops is not great and apart from this largely controllable loss to agriculture the species can be classified as a valuable item of wildlife resources. It is a source of wealth not only in the categories mentioned but also in less tangible aesthetic values of which more and more people are becoming aware.

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